70/80 GHz Recon Petition (WT 02-146)

August 11, 2004

Wireless Communications Association International
Above 60 GHz Committee

Overview

- **The Commission should require advance coordination with non-Government users.**
- **The Commission should leave the 70/80 GHz bands unchannelized and should eliminate or reduce the channel loading requirement.**
- **The Commission should embrace industry proposals for:**
  - **A power/gain tradeoff;**
  - **ATPC for links with EIRP > 23 dB; and**
  - **A power spectral density limit.**
- **The Commission should adopt WCA's proposed interference protection criteria.**
- **The Commission should authorize conditional operation for blanket license applicants.**

Each registrant should be required to verify *in advance* that the proposed link will not cause harmful interference to any previously registered link.

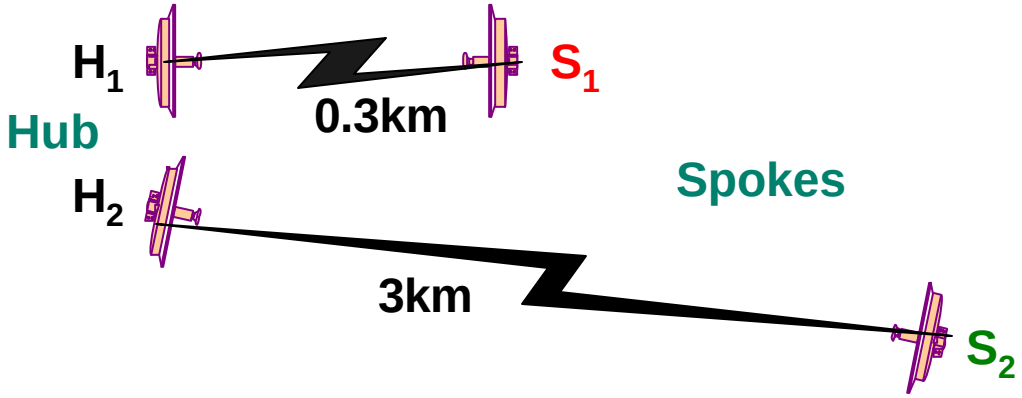
Potential interference should be identified and prevented in advance

- **Current technology permits electronic, real-time interference analysis as a component of the registration process, so the cost of preventing interference is negligible.**
- **By contrast, the consequences of harmful interference discovered only after the fact can be catastrophic – bad enough to disqualify this technology as a viable option for much of the target market.**
- **In a registration-only regime, there may be a long delay between link registration and detection of interference, making it harder to identify and correct the problem after the fact.**
- **Whatever merit there might be in a true *post hoc* regime, the Report and Order imposes *post hoc* procedures on registrants who must already conduct advance interference analysis *vis-à-vis* Government links.**

The self-interest of later registrants is not sufficient to prevent interference

- **If interference prevention is so much better than *post hoc* interference mitigation, why won't registrants do it voluntarily?**
  - **Interference will often be asymmetrical: User 2 may cause interference to User 1 without experiencing any interference in return**
  - **User 2 may or may not recognize his obligation to protect User 1 (*i.e.,* User 2 may be "RF-Naïve")**
  - **User 2 may require a much lower quality of service, and may therefore discount the degree of protection to which User 1 is entitled ("Oh, they can't REALLY need five nines, can they?")**
  - **In marginal cases, User 2's inclination to "chance it" may be increased by the fact that the interference will be User 1's problem if and when it occurs**

Why interference can be asymmetrical



- For rain loss of 15 dB/km (40mm/hr rain rate), short link fades 5dB and long link fades 45dB. At hub location:
  - H_1: C_1/I_2 is improved by 40dB
  - H_2: C_2/I_1 is reduced 40dB
- ATPC (which was not adopted) mitigates this effect but does not eliminate it

The Commission should reconsider its segmentation and channel loading rules.

Segmentation rules add complexity and uncertainty with no corresponding benefit.

- **The segmentation of the band serves no useful purpose in the vast majority of cases, where no scarcity exists.**
- **Even in rare cases of conflict, segmentation boundaries will often be irrelevant to resolutions of the conflict, and may actually impede the optimum coordinated solution.**
- **Segmentation also complicates the channel loading calculation, since occupied bandwidth may not fit neatly into pre-determined segment boundaries.**
- **The Commission should license spatial pipes without regulating the number of bits passing through them.**

Channel loading rules constrain design choices without any apparent benefit.

- **Any loading requirement will be problematic when capacity needs do not fit "neatly" into 1.25 GHz segments**
- **A 1 bps/Hz loading requirement effectively prohibits binary modulation schemes**
- **The combined effect of the segmentation and channel loading rules will be to prohibit some flexible, low-cost frequency plans *(e.g.*, leaving large guard bands).**
- **Once again, the Commission should license spatial pipes without regulating the number of bits per Hertz passing through them.**

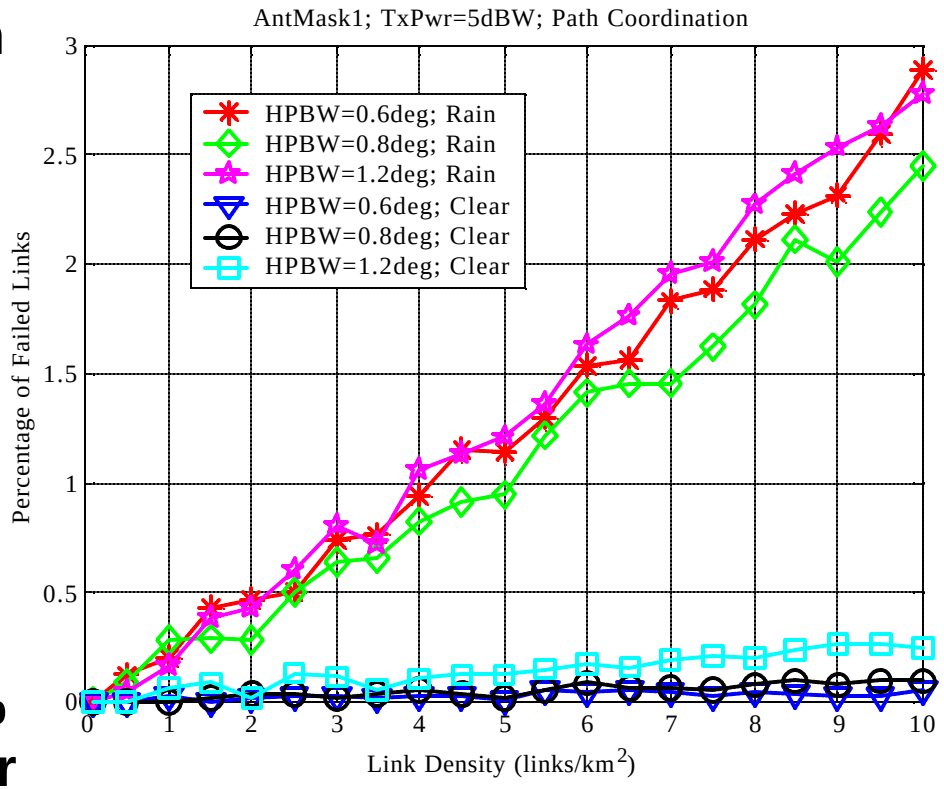
The Commission should embrace industry proposals for a power/gain tradeoff, ATPC, and a power spectral density limit.

The Commission Should Embrace the Industry's Power/Gain Tradeoff

- **The Commission is adopting a one-size-fits-all, 50dBi minimum antenna gain standard, which is typically met using a minimum 2-foot antenna dish.**
- **A 2-foot dish will be less marketable, more costly, and more sensitive to tower and building sway.**
- **The Joint Parties proposed to allow manufacturers to reduce the maximum authorized EIRP by a ratio of 2 dB of power per 1 dB of gain for lower gain antennas. This *added flexibility* would produce**
  - **Less interference; and**
  - **Lower barriers to entry for low-power products.**
- **The Commission should also adopt the Joint Parties proposal for antenna RPE requirements**
  - **The Joint Parties proposed RPE requirements between 1.2° to 5° off boresight as well as a cross-polarization requirement**
  - **The R&O defines a stricter antenna RPE which will necessitate more tapering to reduce antenna sidelobes.**
  - **The Commission cited manufacturing concerns, but the Joint Parties' proposal was vetted with antenna manufacturers and system suppliers for good balance between cost and performance.**

System Performance with Relaxed Antenna Requirements

- This figure compares system performance with 0.6, 0.8, and 1.2 degree half power beamwidth for random deployments.
- System performance is comparable indicating that larger, higher gain antennas are not critical to high link density.
- Link ranges based on 99.99% availability, transmitter power identical for all cases



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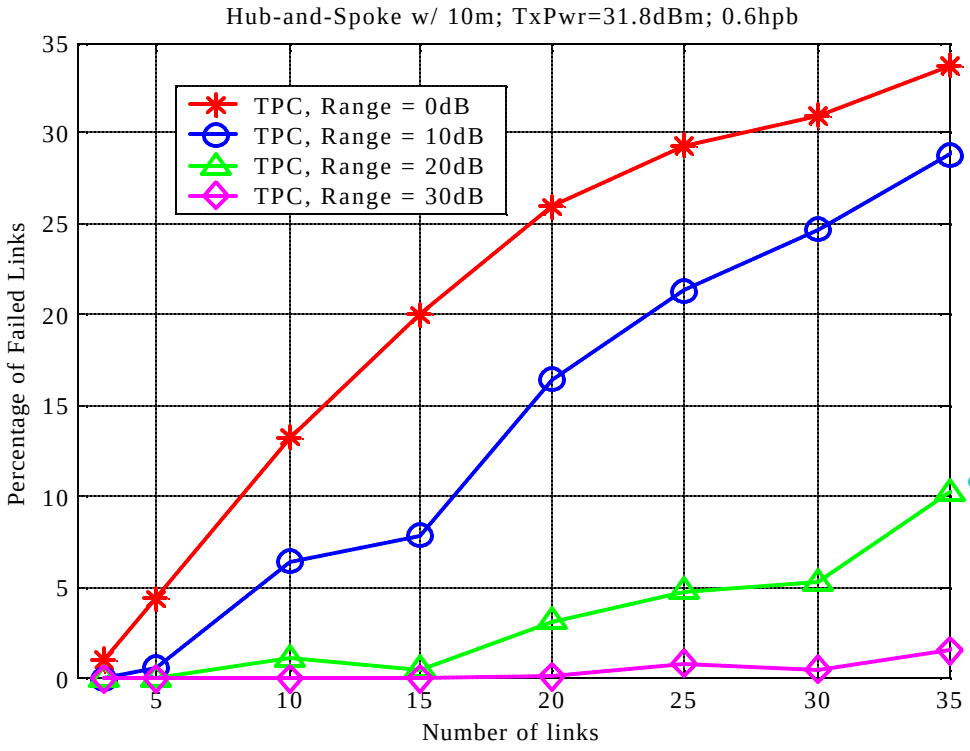
- **ATPC is critical to permit dense hub-and-spoke deployments; it also increases link density in random deployments.**
- **Industry proposal for ATPC permits low-cost, low-power transmitters because no ATPC is required below 23 dBW**
- **Under industry proposal, ATPC dynamic range increases as the radio's maximum EIRP increases.**
  - **ATPC range (dB) = max (0, $EIRP_{dBW}$-23)**
  - **E-band radios manufactured in the near future will have lower EIRPs and consequently low ATPC range—within the capability of near-term devices**
  - **Future high-performance radios will have increased EIRP and ATPC range as technology improves**

ATPC Hub-and-Spoke Simulation Results



- **This figure illustrates the effect of ATPC range on the control of harmful interference**
  - **Interference is problem when a short-range link is on adjacent "spoke" to long-range link**
  - **Rain fading severely attenuates long-range link's signal**
  - **ATPC keeps short-range link transmitter's at lowest possible level, mitigating interference**
- **The percentage of failed links dramatically decreases as the ATPC dynamic range increases**
  - **Industry seeks max ATPC range of 32dB corres-ponding to 55-dBW EIRP transmitter**

The Commission Should Adopt Power Spectral Density Limits

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- **The 70/80GHz bands should be preserved for high bandwidth radios as a wireless alternative for fiber-rate services. Spectrum exists at lower frequencies for narrow band services.**
- **Currently there are no regulations restricting a device from transmitting an EIRP of 55dBW in an arbitrary small bandwidth (*e.g.,* 1MHz).**
- **Such devices would have significantly different spectral and spatial properties.**
  - **Interference between narrow band and wide band devices would be difficult to predict with respect to measurement and calculation of C/I.**
  - **Narrow band devices will have much longer ranges, and would have wide exclusion zones, significantly reducing the deployment of wide band devices.**
- **As a compromise, industry proposal allows for narrowband devices but restricts the spectral density to a maximum of 150mW/100MHz.**

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- **36 dB should be the *maximum* C/I protection, not the minimum.**
  - **Unduly high C/I objectives will limit deployable link density.**
  - **While analog modulation typically requires 55 dB C/I or greater, the difference reflects the expectation of filtering on the analog receiver relative to wideband digital modulation.**
- **The Commission's treatment of the 36 dB number in section 101.147(z) suggests that every link gets at least 36 dB of protection.**
- **The better approach is to amend the interference protection criteria in section 101.105 to cover this band, providing each link with only the protection it needs, and in no event more than 36 dB.**

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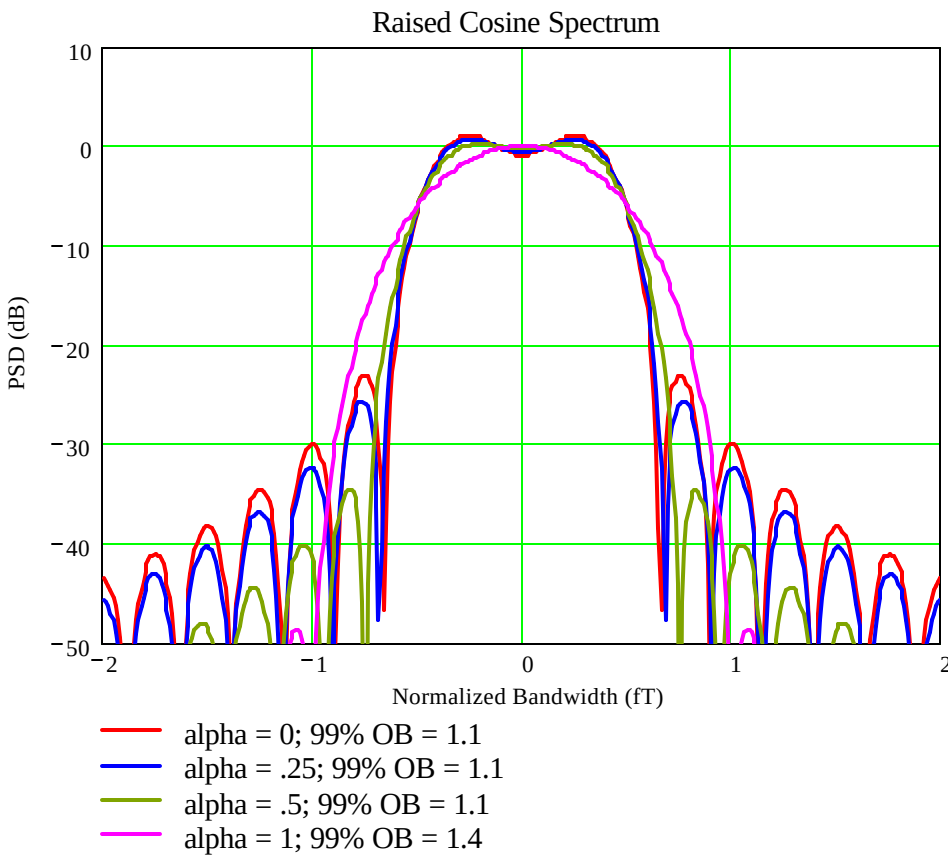
- **WCA assumes this was purely an oversight.**
- **Section 101.31 must be amended to include new frequency bands.**
- **Reference must be made to coordination under new section 101.1523 as well as 101.103**

Appendix

Spectral Efficiency

- **The figure illustrates the spectral occupancy with raised cosine pulse shaping.**
  - **For low barrier to entry, it is desirable to implement simple modulation schemes.**
  - **The requirement of a minimum spectral efficiency of 1 bps/Hz *prohibits* the use of binary signaling such as OOK and BPSK.**
  - **Even QPSK would require significant pulse shaping to reduce the 99% occupied bandwidth.**
  - **If channel coding is desired, such as rate = 1/2, then high order modulation schemes would be required.**
  - **Conclusion: the 1bps/Hz requirement is onerous for radio manufacturers**
- **All simulation results presented herein assume completely co-channel and overlapping signals. Band segmentation has limited incremental value.**



Path Coordination Improves Link Density

- **Monte Carlo simulation result showing probability of harmful interference for hub-and-spoke deployment in rain.**
  - **Assumes FCC R&O rules**
  - **Transmitter power = 32dBm**
- **The figure illustrates significant improvement in the link density in the rain between uncoordinated and coordinated hub-and-spoke deployments.**